

## Mark schemes

**1.**(a)  $I = 0.08$  (A)*an incorrect value of I from the graph can score all subsequent marks*

1

$$0.230 = 0.08 \times V$$

*allow a correct substitution of an incorrectly/not converted value of P*

1

$$V = \frac{0.230}{0.08}$$

*allow a correct rearrangement using an incorrectly/not converted value of P*

1

$$V = 2.875 \text{ (V)}$$

**OR**

$$I = 0.08 \text{ (A) (1)}$$

$$V = 0.08 \times 36 \text{ (2)}$$

$$V = 2.88 \text{ (V) (1)}$$

**OR**

$$0.230 = I \times 36 \text{ (1)}$$

$$I = 0.08 \text{ (A) (1)}$$

$$V = 0.08 \times 36 \text{ (1)}$$

$$V = 2.88 \text{ (V) (1)}$$

*allow a correct calculation using an incorrectly/not converted value of P*

1

(b) the product of current and resistance = a constant

1

calculation of constant (2.88) using three or more pairs of values

*if no other marks scored allow for one mark a statement that doubling one quantity (R or I) halves the other quantity*

1

- (c) current would be (almost) zero (in the variable resistor) 1
- (because) the switch has (effectively) zero resistance  
**or**  
 the potential difference across the variable resistor is (effectively) zero  
*the switch's resistance is much lower than the variable resistor*  
*allow the switch creates a short circuit*

**[8]**

**2.**

- (a) (very high p.d. means) very low currents 1
- which means less (thermal) energy is transferred to surroundings  
*allow less power loss in cables* 1
- which increases the efficiency of power transmission 1
- (b) electric field strength is very high 1
- causing the air to become ionised  
*allow the air breaks down*  
*allow the air becomes a conductor*  
*allow the air conducts charge* 1
- (the kite / string) conducts charge to the person / earth  
*ignore answers referring to the kite touching the power cables* 1
- (c) straight line passing through the origin 1
- line drawn below existing line for all values 1
- (d) the potential difference across the wires/cable is the same 1
- (but) the resistance of the steel wire is greater (and so less current in the steel) 1

**[10]**

- 3.** (a) potential difference  
*allow p.d.*  
*allow voltage* 1
- temperature 1
- in this order only*
- (b) the current increases (when the potential difference increases) 1
- (which) causes the temperature of the filament to increase 1
- (so) the resistance increases  
*do **not** accept resistance increases and then levels off* 1
- (c) a higher proportion / percentage of the (total) power / energy input is usefully transferred
- wastes less energy is insufficient*
- or**
- higher (useful) power / energy output for the same (total) power / energy input 1
- (d) potential difference increases 1
- current decreases 1
- (e) 1000 ( $\Omega$ )
- reason only scores if  $R = 1000$  ( $\Omega$ )* 1
- potential difference is shared in proportion to the resistance  
*allow a justification using a correct calculation* 1

(f)  $12 = I \times 7000$

1

$$I = \frac{12}{7000}$$

1

$I = 1.71 \times 10^{-3} \text{ (A)}$

*an answer that rounds to  $1.7 \times 10^{-3} \text{ (A)}$  scores 3 marks*

1

$I = 1.7 \times 10^{-3} \text{ (A)}$

*this answer only***or**

$I = 0.0017 \text{ (A)}$

*an answer of  $2.4 \times 10^{-3} \text{ (A)}$  scores 2 marks**if no other marks scored allow 1 mark for calculation of total resistance (7000  $\Omega$ )*

1

*an answer of  $1.7 \times 10^{-3} \text{ (A)}$  scores 4 marks***[14]****4.**

(a) 50

1

Hz / hertz

*allow Hertz*

1

(b) (both) switches need to be closed / on

1

to complete the series circuit**or**

to allow charge to flow

**or**

so there is a current in the circuit

1

(c)

*an answer of 7.5 (A) scores 3 marks*  
*an answer of 0.237(A) scores 2 marks*

$$1800 = I^2 \times 32$$

*this mark may be awarded if P is incorrectly or not converted*

1

$$I^2 = \frac{1800}{32}$$

**or**

$$I^2 = 56.25$$

*this mark may be awarded if P is incorrectly or not converted*

1

$$I = 7.5 \text{ (A)}$$

*this answer only*

1

(d)

*an answer of 300 (s) scores 3 marks*  
*an answer of 300 000 (s) scores 2 marks*

$$1500 = \frac{450\,000}{t}$$

*this mark may be awarded if P is incorrectly or not converted*

1

$$t = \frac{450\,000}{1500}$$

*this mark may be awarded if P is incorrectly or not converted*

1

$$t = 300 \text{ (s)}$$

*this answer only*

1

**[10]**

**5.**

(a) risk of electric shock (if someone touched the case)  
*allow risk of electrocution (if someone touched the case)*

1

(b)  $2530 = I \times 230$

*this mark may be awarded if P is incorrectly / not converted*

1

$$I = \frac{2530}{230}$$

*this mark may be awarded if P is incorrectly / not converted*

1

$$I = 11 \text{ (A)}$$

*this answer only**an answer of 0.011 (A) scores 2 marks*

1

*an answer of 11 (A) scores 3 marks*

(c)  $E = 2530 \times 14$

*this mark may be awarded if P is incorrectly / not converted*

1

$$E = 35\,420 \text{ (J)}$$

*this answer only*

1

$$35\,420 = m \times 4200 \times 70$$

*allow their calculated  $E = m \times 4200 \times 70$* 

1

$$m = \frac{35\,420}{4200 \times 70}$$

*allow  $m = \frac{\text{their calculated } E}{4200 \times 70}$* 

1

$$m = 0.12 \text{ (kg)}$$

*allow an answer that is consistent with their calculated value of E*

1

**[9]****6.**

(a) non-contact (force)

*allow electrostatic (force)*

1

attraction (between hair and balloon)

*allow repulsion between the hairs on the head*

1

(b)

*an answer of  $2.0 \times 10^{-6}$  (C) scores 3 marks**an answer of  $2 \times 10^{-3}$  (C) scores 2 marks*

$$0.0050 = Q \times 2500$$

*this mark may be awarded if pd is incorrectly or not converted*

1

$$Q = \frac{0.0050}{2500}$$

*this mark may be awarded if pd is incorrectly or not converted*

1

$$Q = 2.0 \times 10^{-6} \text{ (C)}$$

**or**

$$Q = 0.0000020 \text{ (C)}$$

*these answers only*

1

(c)

*an answer of 120 ( $\Omega$ ) scores 5 marks*

$$0.16 = I \times 4.0 \times 10^{-3}$$

**or**

$$I = \frac{0.16}{4.0 \times 10^{-3}}$$

*this mark may be awarded if time is incorrectly / not converted*

1

$$I = 40 \text{ (A)}$$

*this value only*

1

$$4800 = 40 \times R$$

*allow  $4800 = \text{their calculated } I \times R$* 

1

$$R = \frac{4800}{40}$$

*allow  $R = 4800 / \text{their calculated } I$* 

1

$$R = 120 \text{ ( $\Omega$ )}$$

*allow an answer consistent with their calculated I*

1

**[10]**

- 7.** (a)  $15.7 = \frac{15.8 + 15.3 + X}{3}$  1
- $X = 16.0 (\Omega)$  1
- (b) precise results show little variation 1
- the 4th result was further away from the mean than the other values  
*allow the range of values has increased*  
*ignore the 4th result was an anomaly* 1
- (c) two pairs of values of  $n$  and  $R$  showing that  $n \times R = \text{constant}$   
*e.g.  $2 \times 24 = 48$ ,  $3 \times 16 = 48$*   
 *$4 \times 12 = 48$ ,  $5 \times 9.5 = 47.5$*   
 *$6 \times 8 = 48$*  1
- third pair of values of  $n$  and  $R$  showing that  $n \times R = \text{constant}$  1
- (so)  $n \times R = \text{constant}$  (showing the student was correct)  
*allow 1 mark each for two statements relating the change in number of resistors to the change in (mean total) resistance*  
*allow 1 mark for use of data from graph to confirm at least one statement* 1
- (d) multiple paths for charge / electrons to flow  
*allow current for charge* 1
- total current is greater (for the same potential difference when more resistors are added) 1
- [9]**
- 8.** (a) % increase =  $\frac{(10\,000 - 3200)}{3200} \times 100$  1
- % increase = 212.5 (%) 1

(b) Any **two** from:

- no sulfur dioxide released
- doesn't cause acid rain
- no particulates released
- doesn't cause global dimming
- less carbon dioxide released (per kg of fuel burned)
- less global warming
  - allow less climate change*
  - allow less greenhouse gases*
- no solid waste
- gas mining is less destructive than coal mining
  - ignore less air pollution*

2

(c) mean sea surface temperature shows a (steady) increase

1

over the time period on the graph

*conditional on scoring 1st marking point*

*allow between a correct pair of dates at least 10 years apart*

**or**

from 16.45 (°C) to 16.96 (°C)

*allow a correct pair of temperatures at least 10 years apart*

1

(d) thermistor C

1

(because) the change in resistance is greatest

*conditional on scoring 1st marking point*

*allow the gradient is highest*

*allow more sensitive to temperature change*

1

between 0 and 25 °C

*conditional on scoring 2nd marking point*

*allow between 16 and 17 °C*

*if thermistor C is not chosen, allow for 1 mark each:*

*not thermistor A because there is no/little change in resistance*

*not thermistor B as there is only a small change in resistance*

*not thermistor D as there is no data available between 0 and 40 °C*

1

**[9]**

9. (a)  $5.75 = I \times 230$

1

$$I = \frac{5.75}{230}$$

1

$$I = 0.025 \text{ (A)}$$

1

$$230 = 0.025 \times R$$

**or**

$$R = \frac{230}{0.025}$$

*allow a correct substitution using an incorrect value of I*

**or**

*allow a correct rearrangement using incorrect value of I*

1

$$R = 9200 \text{ (}\Omega\text{)}$$

*allow a correct calculation of resistance using an incorrect value of I*

*alternative approach for 4th and 5th marks:*

$$5.75 = 0.025 \times R \text{ (1)}$$

**or**

$$R = \frac{5.75}{0.025^2}$$

$$R = 9200 \text{ (}\Omega\text{) (1)}$$

*alternative approach:*

$$5.75 = \frac{230^2}{R} \text{ (3)}$$

$$R = 9200 \text{ (}\Omega\text{) (1)}$$

1

- (b) one wire in the switch is live

*allow the switch / circuit is live allow one wire is at a potential of 230 V*

1

the electrician is earthed

**or**

the electrician is at earth potential

1

(so) there will be a (large) potential difference between the live wire and the electrician / earth (if the electrician touched the wire)

1

(c) 50 Hz has the lowest (maximum) let-go current

1

a higher / lower / different frequency would allow people to let go at a greater current  
*allow a specific numerical example as opposed to a trend*

1

**[10]**